FIG. 1

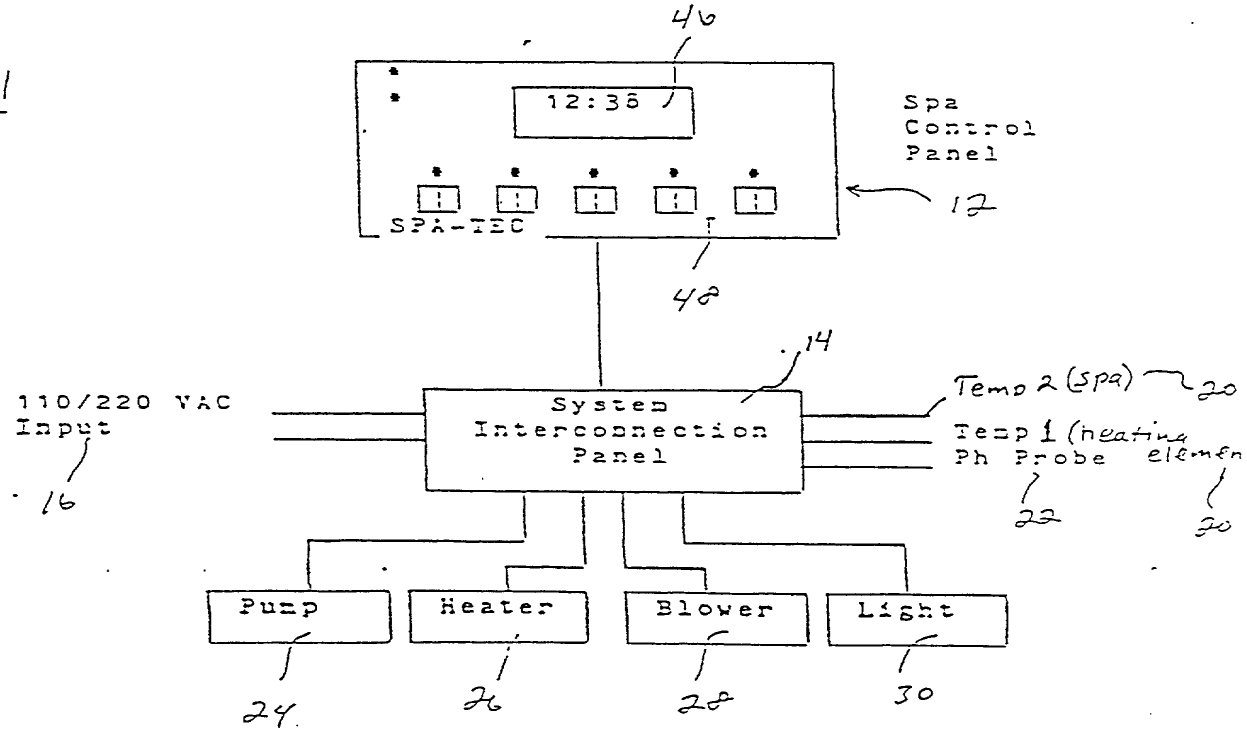

FIG. 2

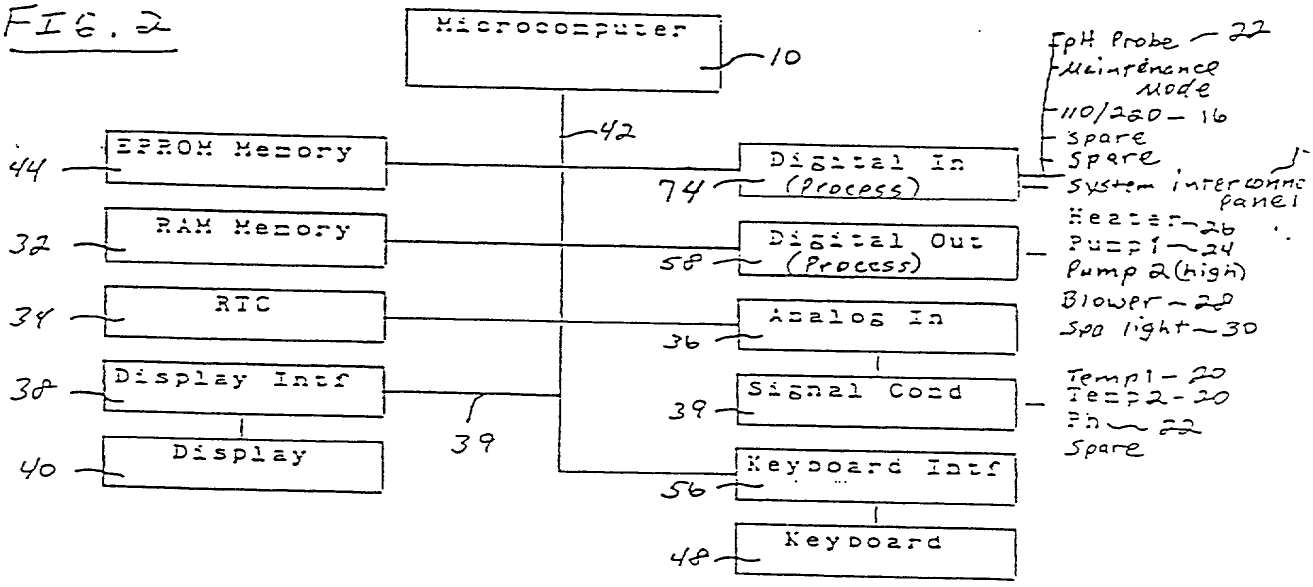
Microcomputer
10
42
EPROM Memory
44
RAM Memory
32
RTC
34
Display Intf
38
Display
40
39
Digital In (Process)
74
Digital Out (Process)
58
Analog In
36
Signal Cond
39
Keyboard Intf
56
Keyboard
48
FpH Probe — 22
Maintenance Mode
110/220 — 16
Spare
Spare
System interconnect panel
Heater — 26
Pump 1 — 24
Pump 2 (high)
Blower — 28
Spa light — 30
Temp 1 — 20
Temp 2 — 20
Ph — 22
Spare

FIG. 3

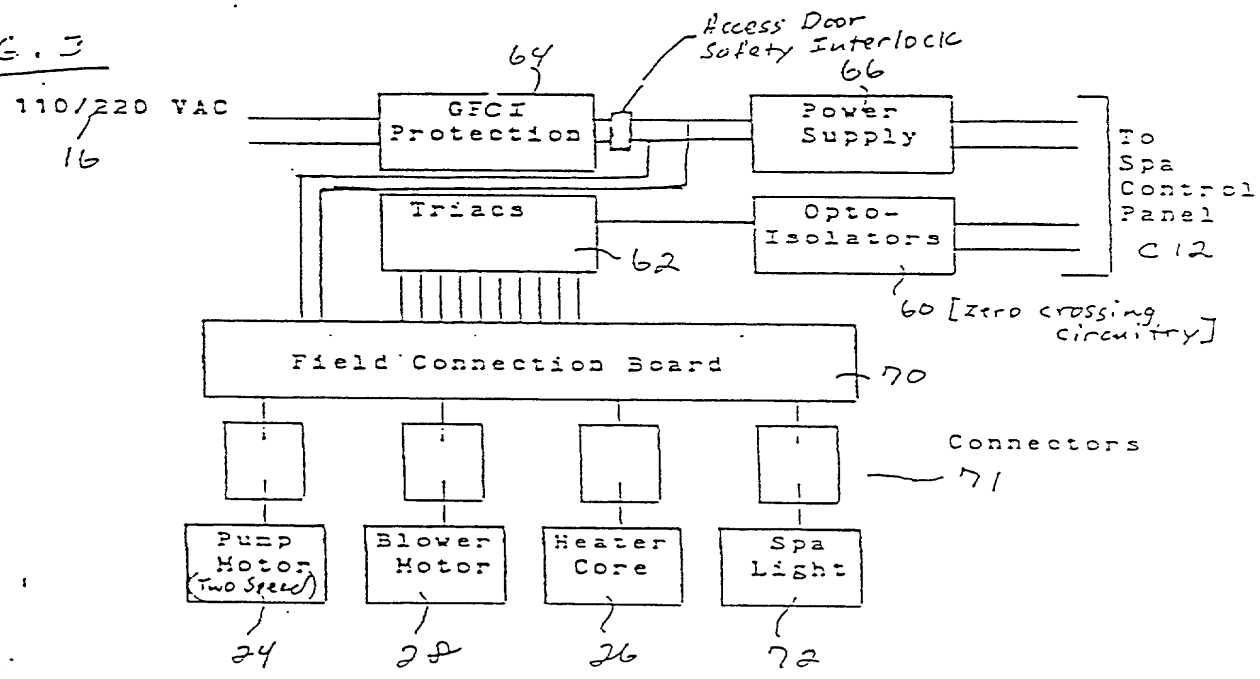
110/220 VAC
16
64
GFCI Protection
Access Door Safety Interlock
66
Power Supply
To Spa Control Panel
C 12
Triacs
62
Opto-Isolators
60 [Zero crossing circuitry]
Field Connection Board
70
Connectors
71
Pump Motor (Two Speed)
Blower Motor
Heater Core
Spa Light
24
28
26
72

FIG. 4

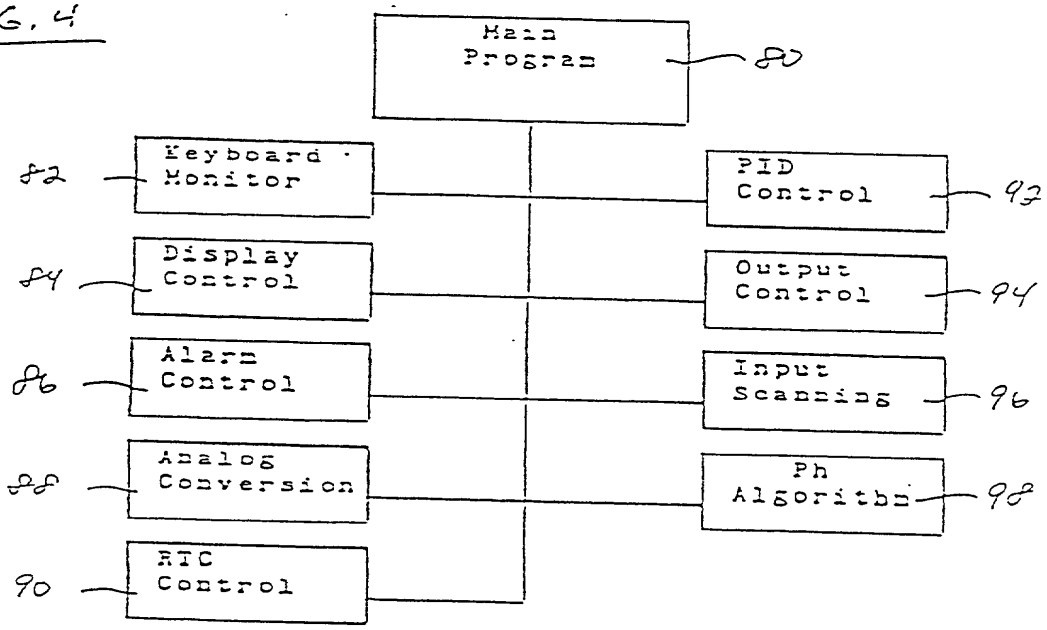
Main Program
80
Keyboard Monitor
82
Display Control
84
Alarm Control
86
Analog Conversion
88
RTC Control
90
PID Control
92
Output Control
94
Input Scanning
96
Ph Algorithm
98

FIG. 5

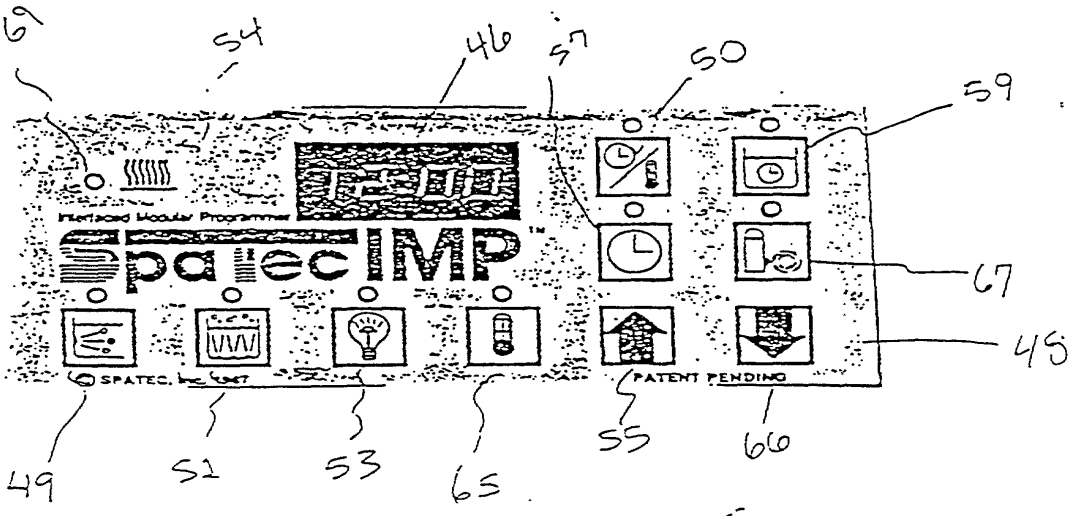
69
54
46
57
50
59
67
45
SPATEC, Inc.
PATENT PENDING
49
51
53
65
55
66

FIG. 6 - Overall flow or control

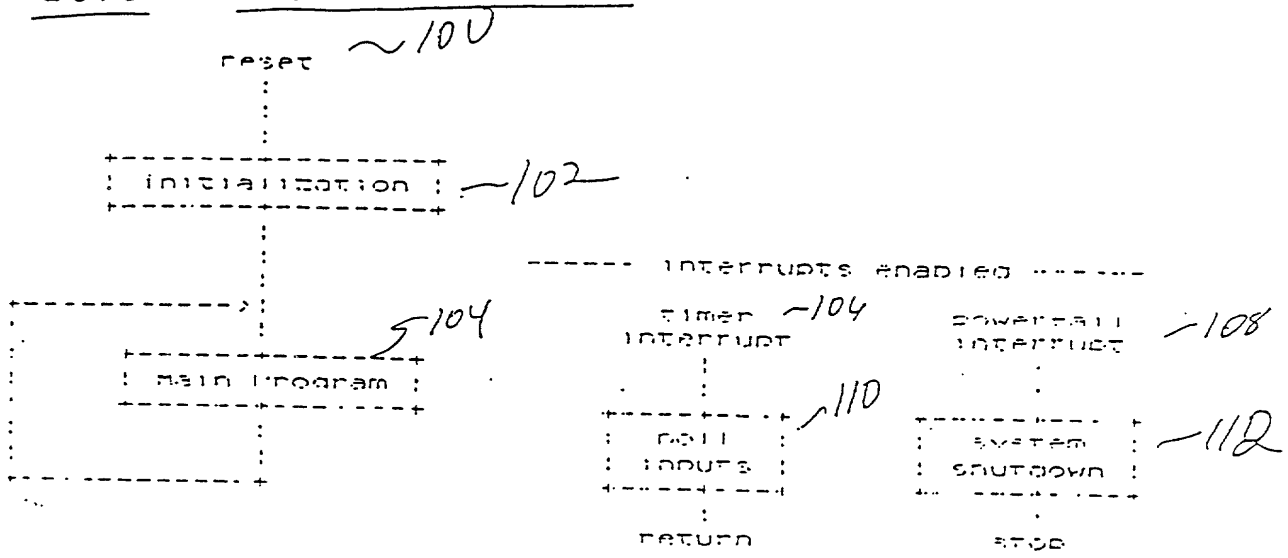

FIG. 7

$Temp_F$ = Desired temperature of Spa water

$Temp_1$ = Temperature at First Sensor (S_1)

$Temp_2$ = Temperature at Second Sensor (S_2)

$Temp_\Delta$ = $Temp_1 - Temp_2$

'Δ_L' = Limit of acceptable temperature difference (plus or minus).

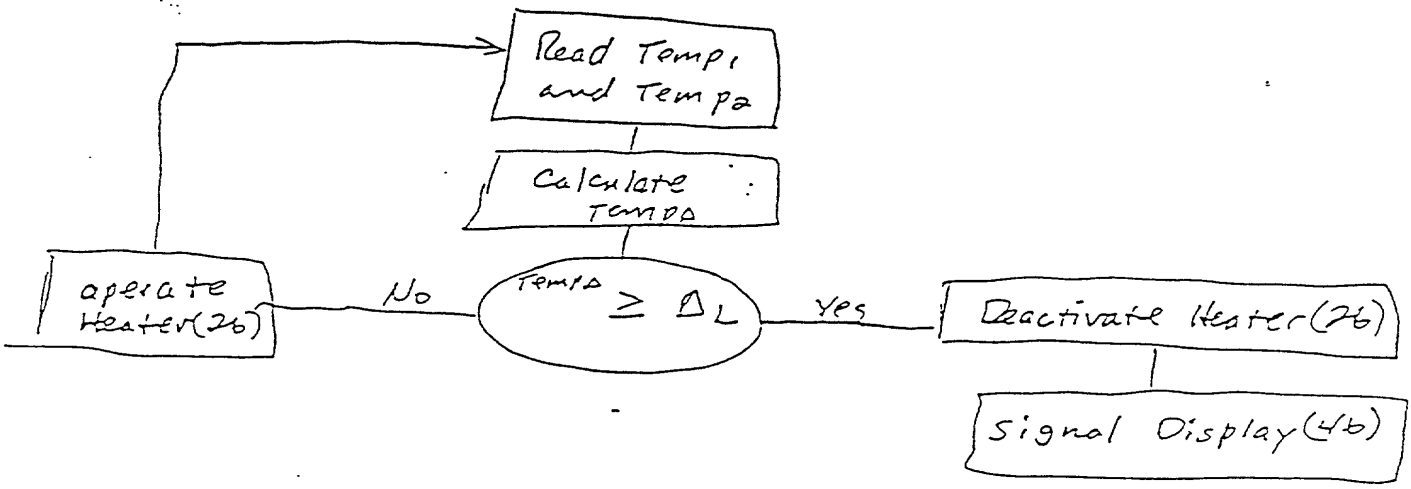

FIG. 8

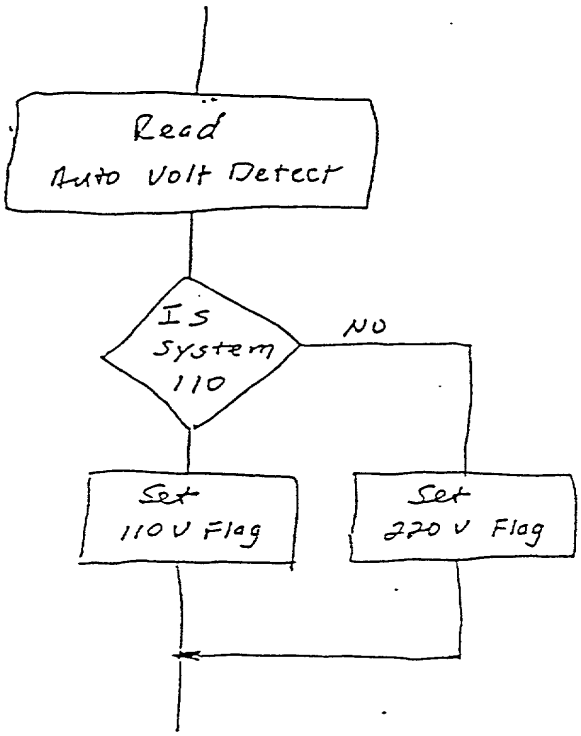
Read
Auto Volt Detect
Is System 110
NO
Set 110 V Flag
Set 220 V Flag

FIG. 9

$Rate$ = Rate of Heating

$Rate_{Av}$ = Rate of Heating (average)

$Temp_F$ = Desired temperature of Spa water

$Temp_I$ = Initial temperature of Spa water

$Temp_\Delta$ = $Temp_F - Temp_I$

$Time_I$ = Time (initial)

$Time_F$ = Time (final)

$Time_\Delta$ = $Time_F - Time_I$

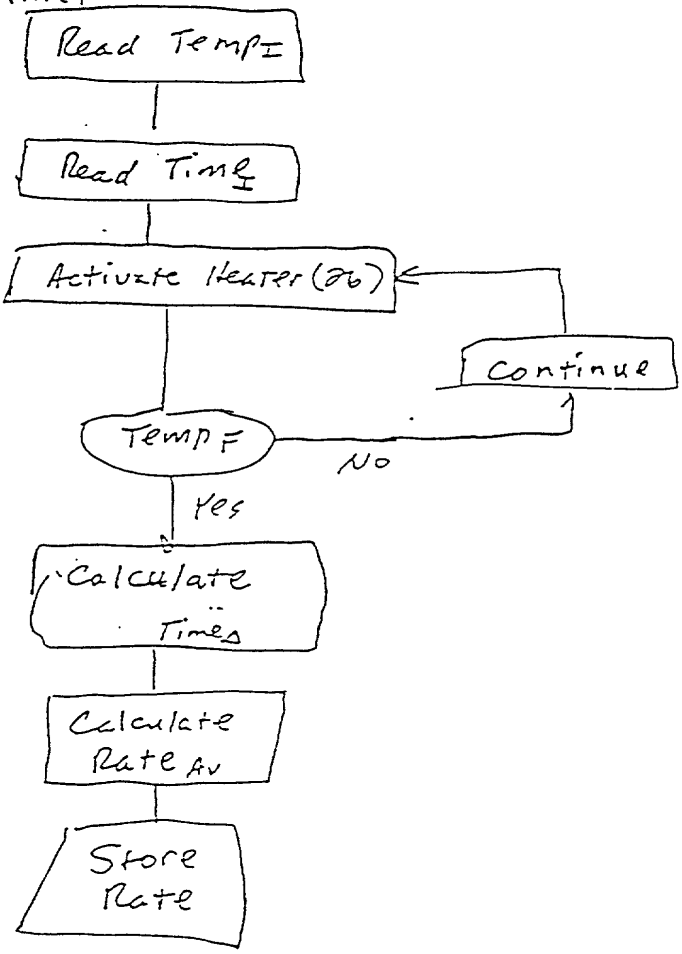

FIG 10

$Temp_I$ = Initial temperature of Spa water
$Temp_F$ = Final temperature (desired) of Spa water
$Temp_\Delta$ = $Temp_F - Temp_I$
Rate = Rate of Heating
$Rate_{AV}$ = Rate of Heating (average)
$Time_I$ = Initial time
$Time_F$ = Final time
$Time_\Delta$ = $Time_F - Time_I$

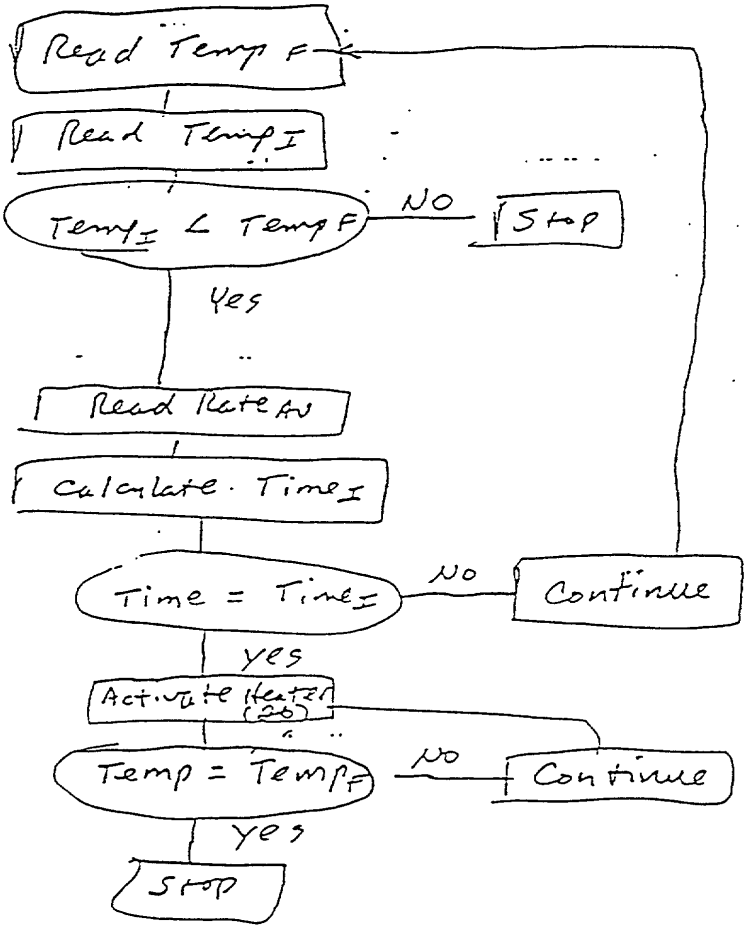

FIG. 11

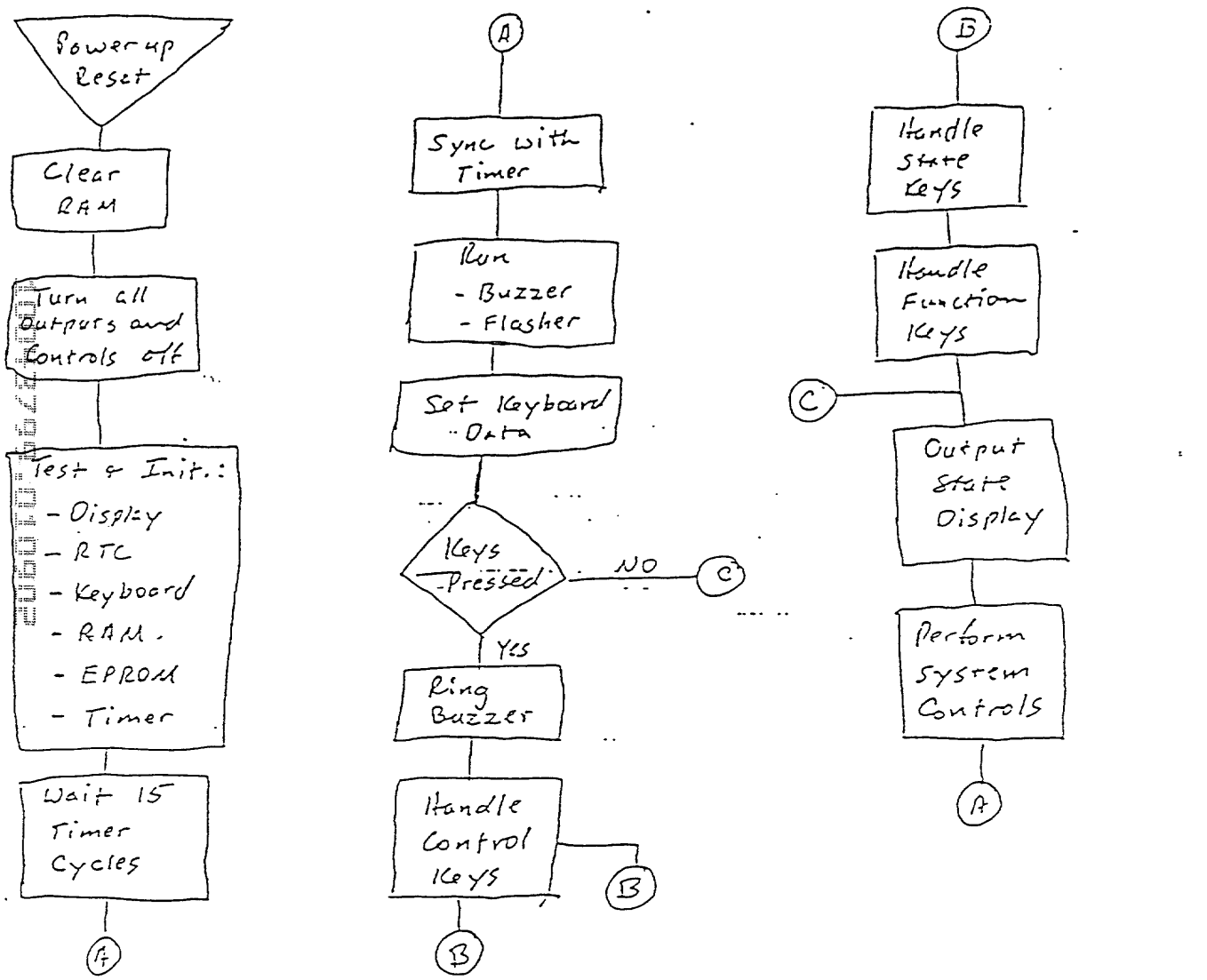

FIG. 12

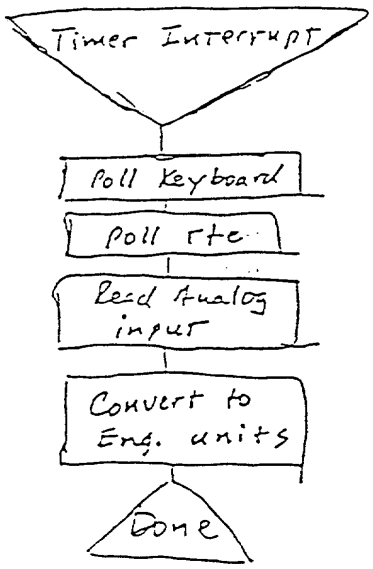

FIG. 13